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# Knowledge, practice, and economic impacts of COVID-19 on small-scale coastal fishing communities in Bangladesh: Policy recommendations for improved livelihoods

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## ABSTRACT

COVID-19 has profoundly impacted global livelihoods and disrupted the food supply chain, including the aquaculture and fisheries industries. Little is known about the response to COVID-19 and the impact it has on incomes, livelihoods and knowledge and practice in the coastal artisanal fishers communities of Bangladesh. Therefore, the aim of this study was to determine the socio-demographics of selected coastal fishers, their knowledge about COVID-19 and the preventive practice taken to reduce it. The impact on their fishing habits and income was also examined to determine potential policy areas. Data were collected via a structured questionnaire from 250 respondents from three coastal districts, Cox's Bazar, Patuakhali and Barguna, Bangladesh during April–June 2020. The research shows that the fishers' knowledge about COVID-19 and measures taken to reduce it were significantly higher in Patuakhali and Barguna than in Cox's Bazar. The pandemic caused lower consumer demand, reduced fish prices and created fish transportation issues due to movement restrictions enforced during the lockdown. Irrespective of geographical location, fishing trips were reduced by frequency and duration compared with the pre-COVID-19 period, consequently lowering the income of fishers. Fishers have received little or no support from private, non-governmental or governmental sources. Considering the evidence in this paper of economic hardship, this paper recommends artisanal fishers in Bangladesh should be provided with support to improve their health education, access to professional health facilities and financial services. This will contribute to improved food security and sustainable livelihoods that can better withstand local and/or global crises.

## 1. Introduction

Novel-coronavirus is currently a global health threat and public health emergency of international concern [1]. The severe acute respiratory syndrome Coronavirus (SARS-COV2) was first reported in Wuhan, China in December 2019 and given the unique name of COVID-19 from the World Health Organization, (WHO) [2]. As a result of a rapid spread of COVID-19, by 11th November 2020, more than 50 million cases were reported in 213 countries, areas, or territories, resulting in more than 1.2 million deaths [2]. In response to this serious

and deteriorating situation, COVID-19 was declared a pandemic and public health emergency of international concern by the WHO on January 30th 2020. They called for collaborative efforts from all countries to prevent its spread [3].

In Bangladesh, the first confirmed case of COVID-19 was reported on March 8th 2020 [4]. The infection rate was low until the end of March but then rose steeply in April 2020. By December 31st 2020, according to the Bangladesh Department of Health, confirmed COVID-19 cases had risen to 514,500, of whom 458,656 (89.15%) patients recovered and 7576 (1.47%) deaths occurred [5]. In Bangladesh, a second wave of

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COVID-19 spread towards the end of March 2021; positive cases increased to a cumulative total of 754,680 and deaths to 11,306. The reported fatality rate was 1.49% on 28 April 2021 [6]. Bangladesh ranked 33rd for COVID world cases, and was 3rd in South-East Asia on the same date [6]. To control and overcome COVID-19, different public health protocols were initiated by different countries, including the use of masks, hand washing, social distancing, and lockdown of cities or other areas. According to WHO [7] the two most important protective control measures against COVID-19 are self-isolation and following social distancing and lockdown guidelines. Similar to other countries, the Bangladesh government announced a full country lockdown from March 26th to May 30th 2020, followed by a partial lockdown, i.e., limited movement of transport, limited access to offices, maintaining strict social distancing, and health guidance. In Bangladesh, educational institutes, including schools and universities, still remain closed at the time of writing this article (January 2021) [5,8] and this continuation has recently been extended until May 22nd 2021 [8]. The widespread lockdown resulted in disruption of the food supply chain and impacted the aquaculture and fisheries sectors, which are now struggling to survive.

Although COVID-19 does not infect aquatic species it has greatly impacted the fisheries and aquaculture food systems [2]. Fisheries and aquatic resources are economically, ecologically, culturally and aesthetically important to Bangladesh. Fisheries contribute 3.5% to the national Gross Domestic Product (GDP) and 26% to agricultural GDP, 1.5% of total export earnings, 60% of supply of animal protein by taking 62.6 g/capita/day, and generates employment for more than 12% of the population [9]. This percentage includes women who are also directly and indirectly contributing to the food security, poverty alleviation and improvements of the fishers livelihoods [9]. In Bangladesh, total fisheries production, based on culture and capture fisheries, come from open and closed inland water bodies (84.69%) and marine water (15.31%) resources. Marine fishing is mainly dominated by Small-Scale Fisheries (SSF),<sup>1</sup> known as artisanal fisheries, and account for approximately 1.5 million fishers. In total, more than 10 million coastal fishers are directly or indirectly dependent on these fisheries for their livelihood [10].

Bangladesh has a shortage of health service providers. The rural health workforce is dominated by informal providers known as 'Village Doctors', of whom less than 5% are trained professionals [11]. Disease prevention and the promotion of public health require careful national and local government preparation and planning. It is important that the public are made aware of how to identify and protect themselves against contagious and persistent diseases. Ferdous et al. [12] and Rahman and Sathi [13] determined that an understanding of attitudes and practices towards COVID-19 in Bangladesh could provide the necessary insight to help determine the type of intervention required to change misconceptions about the virus. On the other hand, numerous studies in Bangladesh [13], the Kingdom of Saudi Arabia [14], Malaysia [15] and China [16] report that some knowledge of COVID-19 directly affects the perception of susceptibility towards the disease, and this knowledge may also influence attitudes and preventive practices. It follows that assessing the knowledge and practices of fishers in relation to COVID-19 would provide fresh insight in helping to address the spread of the disease and the development of preventive strategies and health promotion programs for the vulnerable, small-scale coastal fishers in Bangladesh.

The measures taken to control the spread of COVID-19 have caused disruption in all segments of the domestic and international food supply

chains [17]. The fisheries sector is still subject to indirect impacts of the pandemic through changing consumer demands, market access and logistical problems related to reduced transportation and border restrictions. This sector helps to stock food services and is therefore directly impacted by lockdown measures such as closures of restaurant, hotels, tourist spots, and canteens in schools, colleges and universities, resulting in a lowering of demand for fish supplies. In addition, fish business operators (wholesalers, depot owners, processors, packers, and transporters) have not been able to continue their business due to lack of raw materials in the supply and demand chain and restricted transportation and lack of goods. These factors have had a damaging impact on fishers and their livelihoods and on national food security, which relies heavily on the fisheries sector [18].

During the pandemic, fishing activities have significantly decreased in both the artisanal and industrial fisheries sectors. As a result of COVID-19 related restrictions, global industrial fishing activity has declined by about 6.5% (by the end of April 2020) compared with previous years [19]. The reduction in fishing in parts of Asia, Africa and Europe, as well as international border restrictions, have had significant consequences for the export markets and on higher value seafood such as shrimp and lobster, which predominantly depend on these imported fisheries. Limited supplies of ice, fishing gear and bait, labor shortages and new health measures like the use of face masks and physical distancing between crew at sea, also reduce fishing activity [18]. Geographically, Bangladesh is open to the South with the Bay of Bengal. The southern coastal communities in Cox's Bazar, Patuakhali and Barguna districts are largely reliant on the fishing industry and severely impacted by COVID-19. Various local and global studies have been conducted to identify the impact of COVID-19 on aquaculture and fisheries. Measures to minimize losses to this industry in Bangladesh have been examined by [20–22]. For fisheries and aquaculture in Asia [18], and for global fisheries and aquaculture [17,23,24]. However, there has been no research to assess the fishers' knowledge of prevention practices for Covid-19, nor the impact this has on the small scale sea-going coastal fishers, particularly in relation to their livelihoods. Thus, the aim of this study was to identify the impact of COVID-19 on the small-scale sea going fishers in three coastal districts of Southern Bangladesh and recommend policy measures for sustainable socio-economic improvement of this community.

## 2. Materials and methods

### 2.1. Study area

The carefully selected study areas included three coastal districts of Patuakhali, Barguna and Cox's Bazar in Bangladesh [Fig. 1], where the majority of the community live directly or indirectly from small-scale marine fishing activities. The study duration was 3 months, from April 2020 to June 2020.

### 2.2. Data collection

Primary data was collected from coastal fishers in these districts using a structured questionnaire via face to face interviews. As the interviews were conducted during the COVID-19 pandemic, preventative health protocols were observed, including social distancing and wearing face masks.

The research staff carried extra face masks to freely distribute to the respondents if necessary. There were a total of two hundred fifty (250) respondents including fishers, skippers and boat owners. They were randomly selected based on their availability during data collection. Data collection distribution was 100, 100 and 50 from Cox's Bazar, Patuakhali and Barguna, respectively. The questionnaire included three sections consisting of demographic characteristics, fishers knowledge of COVID-19 and preventative practices, and the impacts of COVID-19 on artisanal sea fishing. The impacts measured included.

<sup>1</sup> According to UN FAO, Traditional fisheries involve fishing households (as opposed to commercial companies), using a relatively small amount of capital and energy, relatively small fishing vessels (if any), making short fishing trips close to shore, mainly for local consumption. Artisanal fisheries can be subsistence providing for local consumption or export. This type of fishing is also known as small-scale sea fisheries. [[www.fao.org/family-farming/detail/en/c/335263/](http://www.fao.org/family-farming/detail/en/c/335263/)]

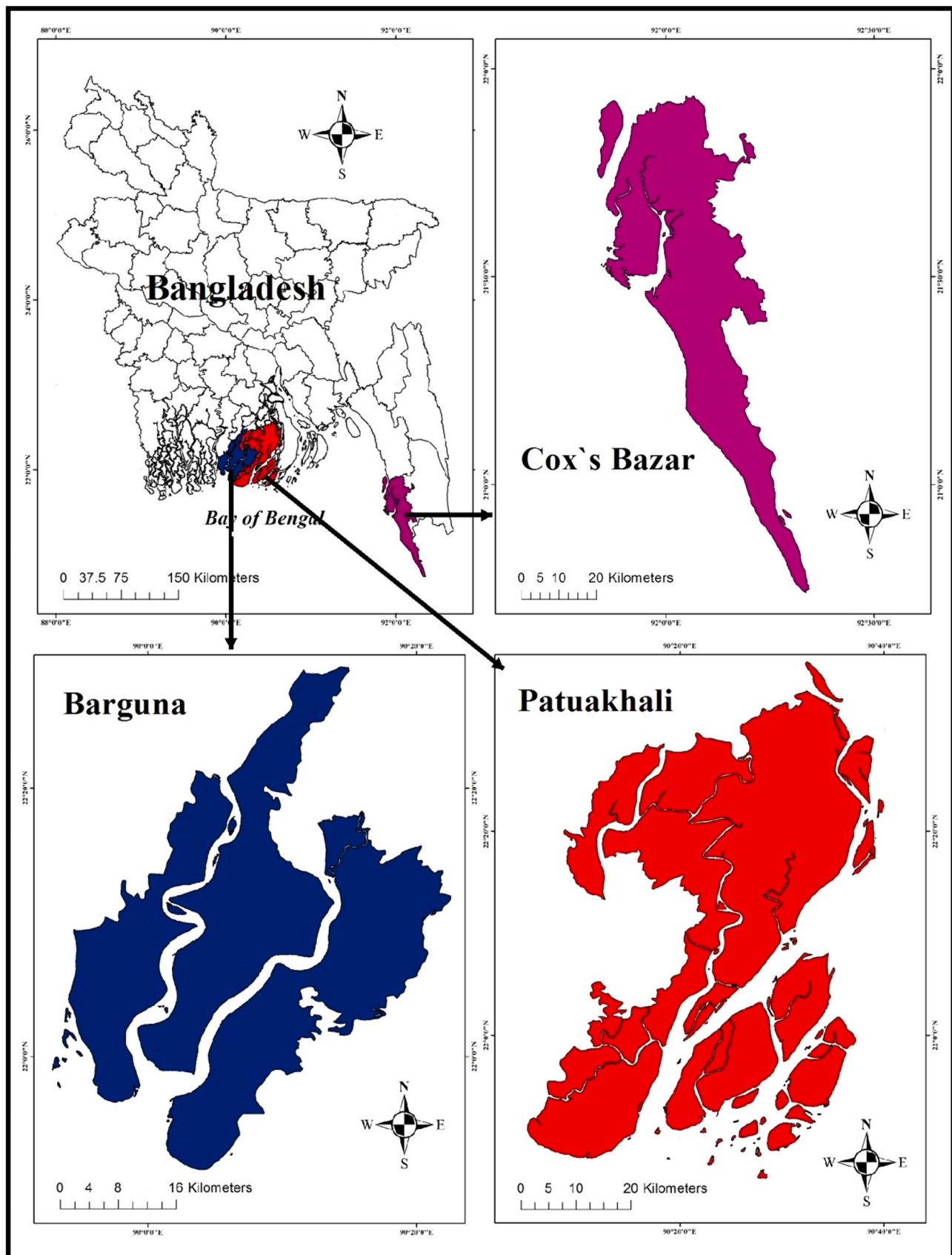


Fig. 1. Map of Bangladesh indicating the study area.

- the income and livelihood status of fishers,
- the number and duration of fishing trips compared with previous year's data pre-COVID-19 (2019),
- alternative income sources if fishing had been stopped,
- COVID-19's impact on the boat and nets, and
- support from the Government, NGOs or other private sources.

Additionally, secondary information was collected from websites including the FAO, WHO and government and non-government organizations and online news. The research was conducted following the ethics approval from the Research and Training Center of Patuakhali Science and Technology University, Bangladesh [PSTU/RTC/21/22(2), Date: 22.04.2021].

### 2.3. Data analysis

The statistical software STATA<sup>2</sup> was used to conduct the analysis. In order to summarize the descriptive findings, percentages, means and standard deviation were used. Statistical significance was considered at  $p < 0.05$ . Logistic regression was used to see the association between various components of knowledge and practices related to COVID-19 and geographic location.

Paired *t*-tests were done to determine if there was a statistically significant mean difference in the monthly income and frequency of fishing before and after the COVID-19 pandemic started. Since the variable 'reduction in monthly income' was not normally distributed, a Kruskal-Wallis H test was conducted to see if the reduction in monthly income after the start of COVID-19 differed for the 3 groups of fishers and also between the three different geographical locations. Likewise, Kruskal-Wallis H test was also conducted to see if the reduction in frequency after the start of COVID-19 differed among the 3 different geographical locations. The best model was constructed to explain the data using a backward stepwise approach. A multiple linear regression was used thereafter to adjust other independent variables and estimate the effect on monthly income after COVID-19. To increase the robustness of the answers, in the analysis we recorded the three categories as follows: 1 fishers, 2 skipper and boat owners, 3 others (boat carpenters and engineers).

## 3. Results

### 3.1. Socio-demography of coastal fishers

Table 1 shows the socio-demographic characteristics of the respondents according to the three research locations. The majority of fishers from the study areas were relatively young, aged between 30 and 49 years with 10–30 years fishing experience. Regardless of the study areas, the majority of fishers had a low level of education with many only being able to write their name.<sup>3</sup> Health services were mainly accessed by fishers through village doctors who only provide a very basic level of care.<sup>4</sup> Table 1 shows specific details on these socio-demographics.<sup>5</sup>

**Table 1**

Socio-demographic characteristics of coastal fishers in Bangladesh.

Parameter	Characteristics	Percentage (%)		
		Cox's Bazar	Patuakhali	Barguna
Age	< 30	18.10	13.00	24.00
	30–39	42.86	26.00	38.00
	40–49	29.52	43.00	28.00
	≥ 50	9.52	18.00	10.00
Gender	Male	100	100	100
	Female	0	0	0
Educational status	Illiterate	16.19	23.00	2.00
	Can write name only	22.86	52.00	88.00
	Up to primary (Grade 1–5)	48.57	19.00	10.00
	Above primary (≥ Grade 6)	12.38	6.00	0.00
Family member	3–5	48.57	58.00	74.00
	6–8	47.62	38.00	22.00
	≥ 8	3.81	4.00	4.00
Health facility	Village Doctor	100	84.35	19.23
	Community Health Clinic	0	13.91	78.84
	Sub-district level Hospital (govt.)	0	1.74	1.92
Occupation	Fishing	99.05	100	100
	Others	0.95	0	0
Type of fishers	Fishers	83.81	56.00	56.00
	Skipper and Boat owner	15.24	42.00	30.00
	Others (Carpenter, Engineers)	0.95	2.00	14.00
Fishing experience (years)	< 10	16.19	9.00	12.00
	10–19	59.05	28.00	46.00
	20–29	18.10	46.00	32.00
	≥ 30	5.71	17.00	10.00

### 3.2. Coastal fisher's knowledge about COVID-19 and corresponding preventive measures

Table 2 shows the logistic regression analysis of variables related to knowledge of COVID-19 by geographic locations. Knowledge about different symptoms of COVID-19 were seen to have a statistically significant association with the geographic location. The probability of fishers of Patuakhali having knowledge about respiratory problems was found to be higher than with the fishers of Cox's Bazar (OR = 7.09,  $p < 0.05$ ). While the probability of fishers of Patuakhali having knowledge about avoiding crowds and not coughing outside was found to be lower in comparison with the fishers of Cox's Bazar (OR = 0.15, and OR = 0.18 at  $p < 0.05$  respectively). Knowledge about regular hand washing was found higher in Barguna than Cox's Bazar (OR = 2.41,  $p < 0.05$ ) (Table 2).

Table 2 also shows the logistic regression analysis of variables related to precaution measures taken against COVID-19 with geographic location. These preventive practices were found to have statistically significant association with the geographic location. The fishers of Barguna were found to have higher probability of using masks (OR = 15.87,  $p < 0.05$ ) and regular hand washing (OR = 13.81,  $p < 0.05$ ) than the fishers of Cox's Bazar. For same precautions the fishers of Patuakhali had also higher probability (OR = 8.03 and OR = 2.17 at  $p < 0.05$ , respectively) than the fishers of Cox's Bazar (Table 2). Similarly, the practice of not coughing outside was also found to have statistically significant association with the geographic location (OR = 0.20,  $p < 0.05$ ).

### 3.3. Impact of COVID-19 on coastal small scale fishers in Bangladesh

Table 3(A) shows the effects of COVID-19 on coastal fishers in Bangladesh. In Cox's Bazar, the percentage of fishers earning < 10,000

<sup>2</sup> [www.stata.com](http://www.stata.com)

<sup>3</sup> A 'village doctor' provides a private health service and may have medical training to give advice as a drug vendor at local pharmacy but has no professional medical degree.

<sup>4</sup> A 'community health clinic' is a government health service at community level where an assistant doctor or community health worker gives health service and basic routine services. Minimal diagnostic facilities would be available.

<sup>5</sup> A 'government hospital, at sub-district level has health services overseen by specialized doctor and nurses with access to diagnostic and emergency facilities.



**Table 2**

Logistic regression analysis of knowledge and precautions measures of COVID-19 with geographic location.

Parameter	Variables	Odds Ratio (OR)	95% Confidence Interval	p-value
Knowledge	Knowledge on neckache as a symptom	1.77 (2 wrt 0)	0.98–3.21	0.060
	Knowledge on lack of taste and smell sensation as a symptom	0.74 (2 wrt 0)	0.37–1.47	0.390
	Knowledge on respiratory problem as a symptom	7.09 (2 wrt 0)	3.53–14.23	0.000 <sup>a</sup>
	Knowledge on avoiding crowds as a preventive measure	0.15 (2 wrt 0)	0.07–0.29	0.000 *
	Knowledge on regular hand washing as a preventive measure	2.41 (1 wrt 0)	1.01–5.69	0.046 <sup>a</sup>
		1.83 (2 wrt 0)	0.97–3.48	0.063
	Knowledge on not coughing outside as a preventive measure	0.87 (1 wrt 0)	0.44–1.71	0.690
		0.18 (2 wrt 0)	0.09–0.35	0.000 <sup>a</sup>
	Knowledge on social distancing as a preventive measure	1.72 (2 wrt 0)	0.99–3.01	0.054
	Practice of using face masks	15.87 (1 wrt 0)	5.80–43.39	0.000 <sup>a</sup>
Practice		8.03 (2 wrt 0)	4.20–15.34	0.000 <sup>a</sup>
	Practice of avoiding crowds	0.62 (2 wrt 0)	0.24–1.55	0.305
	Practice of regular hand washing	13.81 (1 wrt 0)	6.09–31.31	0.000 <sup>a</sup>
		2.17 (2 wrt 0)	1.05–4.46	0.036 <sup>a</sup>
	Practice of not coughing outside	0.72 (1 wrt 0)	0.24–2.13	0.555
		0.20 (2 wrt 0)	0.05–0.72	0.014 <sup>a</sup>
	Practice of social distancing	0.25 (1 wrt 0)	0.03–2.03	0.194
		1.49 (2 wrt 0)	0.57–3.89	0.406

<sup>a</sup> means statistically significant, 'wrt' means 'with respect to/compared to', 0 refers to Cox's Bazar, 1 refers to Barguna and 2 refers to Patuakhali, 1 wrt 0, means that the odds ratio corresponds to Barguna with respect to Cox's Bazar; Cox's Bazar has been taken as the reference group during the regression analysis.

Bangladeshi Taka (equivalent 117.92 USD) increased from 6.67% to 36.19% after March 2020 (corresponding to the first Corona patient in Bangladesh). A similar trend was noted of an increasing percentage of fishers with a reduced income in Patuakhali and Barguna. The majority (93–99%) in all three locations said that COVID-19 had impacted on their fishing activity.

Before Covid-19, fishers from Cox's Bazar went day fishing between 20 and 25 days per month but during Covid-19 and the study period, day fishing was reduced to less than 20 days (Table 3A). Fishing trips of longer than a day were also reduced significantly from 7 to 15 days down to 4–6 days in each study area (Table 3A).

In three study areas, the majority (76–100%) of fishers answered that they hadn't received any special support during the pandemic. Out of the few fishers who had received support, all said that it was "not enough" (Table 3B). Fishers were asked what kind of support they expected from the government, 54–68% prioritized food rations and 13–50.48% prioritised financial support, irrespective of geographical location. No financial or food support from the government was acknowledged by the fishers. All the survey respondents in Cox's Bazar felt that the shorter fishing trips had caused deterioration of their nets and boats from under-use, while 38.10% said that the Corona crisis would result in less fishing. In Barguna, 36% said that the crisis would impoverish fishers and (46%) felt the same way in Patuakhali. All respondents in Cox's Bazar and the majority in Barguna (84%) and Patuakhali (69%) said that fishing would be under serious threat if the Corona crisis continues. When asked their opinion on how to overcome the impacts from the Corona crisis, 33.33% of fishers in Cox's Bazar said that they needed better transport for their fish while 46% of fishers in Patuakhali and Barguna did not express any opinion (Table 3B).

The two following quotes taken from the research findings emphasise the fisher's concern:

*"we are not scared of corona but [are] scared of hunger" and*

*"Corona is the disease for rich people, not [of the] poor".*

### 3.3.1. Differences in monthly income according to type of fishers and geographical area

Since the variable 'reduction in monthly income' was not normally distributed, a Kruskal-Wallis H test was conducted to see if the reduction in monthly income after the start of COVID-19 differed for the 3 groups of fishers and for the three geographical areas. The test showed (Table 4) that there is a significant difference in the monthly income during

**Table 3**

(A) Impact of COVID-19 on the small-scale coastal fishers of Bangladesh. (B) Support for small-scale coastal fishers in Bangladesh to alleviate COVID-19 impacts.

Questions	Answer range	Percentage (%)			
		Cox's Bazar	Patuakhali	Barguna	
(A)					
Monthly income (in BDT) before March 2020	< 10,000	6.67	1.00	8.00	
	10,000– 19,000	79.05	46.00	48.00	
	20,000– 29,000	11.43	26.00	14.00	
	≥ 30,000	2.86	27.00	30.00	
Monthly income (in BDT) after March 2020	< 10,000	36.19	28.00	72.00	
	10,000– 19,000	56.19	49.00	22.00	
	20,000– 29,000	7.62	17.00	4.00	
	≥ 30,000	0.00	6.00	2.00	
How has COVID-19 affected fishing	Lack of labour	26.67	83.00	26.00	
	Low price of fish	100	56.00	68.00	
	Concern of infection	31.43	49.00	30.00	
	Fish transportation problems	25.71	56.00	92.00	
	Lack of processing systems	0.00	0.00	14.00	
	Lack of ice/ Higher price of ice	14.29	6.00	0.00	
	Fishing times/month before corona (in days fishing)	20–22	7.62	0.00	0.00
	> 25	15.24	0.00	0.00	
Fishing times/month after corona (in days fishing)	17–19	39.05	0.00	0.00	
	20–22	13.33	0.00	0.00	
	23–25	31.43	0.00	0.00	
Fishing times/month before corona (in trips of fishing where trip duration: 7–15 days)	No trip	18.10	0.00	0.00	
	1–2 trips	0.00	0.00	0.00	
	3–4 trips	15	34	36	
	5 and above trips	85	66	64	
	7–15 days	0.00	0.00	0.00	
Fishing times/month after corona (in trips of fishing where trip duration: 4–6 days)	No trip	0.95	2	10	
	1–2 trips	11.43	40	78	
	3–4 trips	25.71	52	12	
	5 and above trips	0.00	6	0	
Fishing comparison to other years	Less	100	79	88	

(continued on next page)

Table 3 (continued)

Questions	Answer range	Percentage (%)		
		Cox's Bazar	Patuakhali	Barguna
Stopped fishing due to corona crisis	Higher	0	1	0
	Same	0	17	0
	Stopped/No	0	3	12
	Yes	0	13	84
	No	86.67	87	16
	Partly	13.33	0	0
(B)				
Special support received by fishers	Yes	0	24	4
	No	100	76	96
Sources of support	Govt. organizations	0	0	4
	NGOs	0	23	0
	Local	0	1	0
	Yes	0	1	0
Is it sufficient?	No	0	23	4
	No expectation	0	16.00	0.00
Expected support from the government	Food rations	61.90	54.00	68.00
	Financial support	50.48	13.00	40.00
	Loan without/less interest	0.00	21.00	0.00
	Protective equipment	32.38	0.00	0.00
Alternative income source	Life insurance	0.00	0.00	2.00
	Does this damage fishing nets/boats?	Yes	100	12
	No	0	88	38
	Will fishing face a big threat if Corona crisis continues	Yes	100	69
If the crisis continues, what are the problems faced by fishing sector?	No	0	31	16
	No idea	38.10	6	16
	No problem	0	26	22
	Less fishing	38.10	46	10
Poverty of fishers	Poverty of fishers	0	23	36
	Fishers change their profession	0	11	6
	Low fish supply	36.19	3	0
	Transportation problem	0	5	6

COVID-19 between the three groups of fishers ( $p < 0.05$ ) as well as the three geographical areas ( $p < 0.05$ ). More specifically, the mean reduction of monthly income was 13.23–49.07% in the fishers groups, and 15.43–64.68% in the geographical locations (Table 4). The highest income reduction by 'Fisher Type' was experienced by the skippers and boat owners (49.07%), and for location, Barguna was most impacted (64.68%).

### 3.3.2. Differences in frequency of fishing according to geographic location

A Kruskal-Wallis H test was also conducted to see if the change in frequency of fishing after the start of COVID-19 differed between the geographical areas. The test showed that there is a significant difference in the frequency of fishing after the start of COVID-19 between the geographical area (Table 4), ( $p < 0.05$ ). The result showed that Barguna was the most affected area with a reduction of 44.05% in fishing frequency followed by Cox's Bazar 18.65% and Patuakhali 7.14% (Table 4).

### 3.3.3. Differences in monthly income and frequency of fishing (irrespective of fishers group and locations)

A paired *t*-test was done to determine whether there was a statistically significant mean difference between the monthly income before the COVID-19 pandemic and after the COVID-19 pandemic started

Table 4

Effects of COVID-19 on mean monthly income by type of fishers, location and frequency in fishing before and after COVID-19 pandemic.

Type of fishers	Income before COVID-19	Income reduction after start of COVID-19	% of Income reduction	P-value
Fishers	153.37 ± 35.30 USD	40.56 ± 89.66 USD	26.45	0.0001
Skipper and Boat owners	359.18 ± 109.86 USD	176.25 ± 115.24 USD	49.07	
Others (Carpenters and Engineers)	266.45 ± 29.58 USD	35.27 ± 35.27 USD	13.23	
Geographical location	Income before COVID-19	Income reduction after start of COVID-19	% of Income reduction	P-value
Cox's Bazar	171.18 ± 60.27 USD	26.42 ± 93.40 USD	15.43	0.0001
Barguna	252.61 ± 161.90 USD	163.40 ± 110.32 USD	64.68	
Patuakhali	256.14 ± 120.58 USD	103.73 ± 112.13 USD	40.50	
Geographical location	Fishing frequency before COVID-19	Reduction in fishing frequency after start of COVID-19	% of Fishing reduction	P-value
Cox's Bazar	17.59 ± 11.12	3.28 ± 2.57	18.65	0.0001
Barguna	2.86 ± 0.81	1.26 ± 0.83	44.05	
Patuakhali	3.08 ± 0.93	0.22 ± 0.76	7.14	

[1 United States Dollar (USD) to 85.07 Bangladeshi Taka (BDT). Exchange rate by Bangladesh Bank on 01.01.2021]. Bangladesh local currency 'BDT' was converted to USD.

Table 5

Effects of COVID-19 on frequency of fishing and monthly income of fishers, before and after COVID-19 pandemic.

Variable	Mean	95% Confidence Interval
Monthly income before COVID-19	221.66 USD	206.96–236.37
Monthly income after COVID-19 start	138.48 USD	126.43–150.53
Difference in monthly income	−83.18 USD	−97.72 to −68.64
Frequency of fishing before COVID-19	9.01	7.76–10.26
Frequency of fishing after COVID-19 start	7.33	6.31–8.34
Difference in frequency of fishing	−1.68	−1.96 to −1.41

[1 United States Dollar (USD) to 84.80 Bangladeshi Taka (BDT); Exchange rate by Bangladesh Bank on 21.12.2020]. Bangladesh local currency 'BDT' was converted to USD.

(Table 5), irrespective of fishers group and locations. There was a statistically significant decrease in mean monthly income by 7053.78 Bangladeshi Taka equivalent to 83.18 USD after the COVID-19 pandemic started ( $p < 0.05$ ) (Table 5). A paired *t*-test was done to see the difference in fishing frequency (irrespective of area) and found a statistically significant decrease in mean frequency of fishing by 1.68 after the pandemic started ( $p < 0.05$ ) (Table 5).

Stepwise regression analysis was used at 10% *p*-level to predict important predictors of monthly income after COVID-19. Age, frequency of fishing after COVID-19 and fishing experience were removed from the model since the *p*-values were greater than 0.1. Type of fishermen, family size and geographical location remained in the model.

Multiple linear regression was used thereafter to estimate the effect of the predictor variables on monthly income after COVID-19. The monthly income after COVID-19 was 8307.98 Taka less in Barguna compared to Cox's Bazar ( $<0.001$ ) when adjusted for type of fishers and

family size. The monthly income after COVID-19 was 1275.16 Taka less in Patuakhali compared to Cox's Bazar when adjusted for type of fishers and family size but this estimation was not statistically significant ( $p = 0.24$ ).

#### 4. Discussion

##### 4.1. Socio and geographical impacts on fisher's knowledge and practices of COVID-19

The current study investigated the socio-demographics of coastal fishers in relation to their COVID-19 knowledge and understanding of preventative practices. In this study, most of the respondent fishers were between 30 and 50 years old (Table 1), which is usually the most healthy and vital stage of life when they are likely to be supporting both young children as well as elderly parents at home. As the main bread winner of the family, fishers are heavily relied on to provide food security to their families and other needs such as their children's education.

Among the fishers from the three geographical locations, better knowledge about COVID-19 and preventive practices to combat the disease existed in Patuakhali and Barguna than in Cox's Bazar (Table 2). This might suggest a correlation with the higher literacy rate of the population in the respective area. In our study areas, Barguna had the highest literacy rate (2%, in Table 1) compared to the other two study areas. As per national data, the literacy rate of Cox's Bazar, Patuakhali and Barguna district is 30.18%, 54.1% and 62.10%, respectively [25]. Similar findings were made by reported by Rahman and Sathi [13] and Ferdous et al. [12] regarding better knowledge about COVID-19 resulting in better prevention practices.

Irrespective of the geographical location, three different types of health services (Table 1) exist where fishers have access to village doctors and the community health clinic. Fishers with greater knowledge about COVID-19 in Barguna and Patuakhali, recorded a higher application of preventive practice than in Cox's Bazar (Table 2), which also agrees with the result of health facilities in the respective areas. The majority of Barguna fishers (84.35%) used health services from the community health clinic, whereas the village doctor's service was used more by those in Patuakhali (85%) and Cox's Bazar (100%). These results are in accord with geographical differences where the Bangladesh government made localised alerts to the population about the COVID-19 risks in the respective areas. In June 2020, the Bangladesh government established color-coded classifications in 18 districts. Cox's Bazar was put into a red (high-risk) zone, meaning an area with 40 or more cases of COVID-19 per 100,000 people. However, Patuakhali and Barguna were not classified as high risk [26]. To minimize the COVID-19 health risk of coastal fishers, the local health service could play a role in providing primary health information on COVID-19, its prevention and control measures. The Bangladesh Preparedness and Response Plan, BPRP [27] for COVID-19 emphasised making use of the local community health capacity (community clinic and sub-district level hospital) as primary health services for the community-based prevention practices, case identification, and quarantining targeting to slow the spread of disease following lockdown. However, the BPRP COVID-19 [27] stated that primary health care is managed by the local government institutes, which are poorly regulated; thus, improved and well regulated health facilities are required for the general community, including fishers.

Tertiary and specialized public hospitals in the urban health service ensure improved delivery of comprehensive health services. This includes primary health care to the urban population in Bangladesh, which is currently unavailable to the fisher community. Similar relationships between knowledge of COVID-19 and preventative practices were also reported in the Kingdom of Saudi Arabia on MERS-CoV [14], Malaysia on COVID-19 [15] and China on COVID-19 [16]. This is an important association, particularly where unavailability of a vaccine and medical treatments exists. It highlights an area where government intervention could make a positive difference to all citizens, particularly

those within the lowest income bracket in the poorest regions of the country, such as the artisanal fishers in Southern Bangladesh.

##### 4.2. COVID-19 impact on income and fishing activity in relation to geographical variation

Fishers were profoundly affected by COVID-19 with significant lowering of income for both day and longer fishing trips due to less time at sea, regardless of the geographical locations (Table 3A, Table 4 and Table 5). Lower fish prices were associated with less demand for fish in Cox's Bazar (78.10%) and Patuakhali (83%) while in Barguna (88%), transportation problems were caused by travel restrictions and lack of drivers and transporters. The COVID-19 impact on fishing varied by location amongst the three study areas. Cox's Bazar is the main tourist area in Bangladesh and where good seafood attracts visitors. However, the COVID-19 lockdown restricted tourists and lowered the demand for fish, consequently reducing its value. In Patuakhali, fishers are mostly migrant workers from the neighbouring districts like Barisha, Bhola, Jhalokathi, who were unable to travel during lockdown, resulting in a labor crisis. Barguna is the most southerly district in the country where marine captured fish are transported to other districts. With the COVID-19 travel restrictions this trade was also crucially impacted. The majority of fishers in all three of the study areas stated that they fished less compared to other years because of the pandemic. Other studies concur with these findings in different areas of Bangladesh [17,18,22–24]. McCloskey and Heymann [28] reported that economic growth could be slowed down by as much as 1.9% of GDP if the pandemic lasts for 9 months, due to the low market price and supply chain disturbances such as those experienced in the fisheries of Bangladesh.

Day and/or longer duration fishing trips also differed by regions. For example, in Cox's Bazar fishers went on both day and longer fishing trips while in Patuakhali and Barguna only longer fishing trips were made (Table 3A). Regardless of the study area, both day and longer fishing trips were largely reduced in terms of frequency during COVID-19. As a result, income reduction was more prominent in Patuakhali (40%) and Barguna (65%) than Cox's Bazar (15%) (Table 4). The daily fishing trips made in Cox's Bazar might have helped the fishers to reduce their income loss as compared with the fishers from Patuakhali and Barguna. Among the three types of respondents, income reduction (13–26%) was comparatively lower for fishers and in the 'others' group (carpenters and engineers) than for the skippers and boat owners (49%). This suggests that the two former groups might also have found alternative income sources such as local farming, agriculture, and/or daily labor to help their livelihoods and improve food security for their families. On the other hand, frequency reduction of fishing was higher in Barguna (46%) compared to the other two locations, indicating that fishers in this area are largely affected and struggle for their livelihoods and food security during the COVID-19 pandemic situation. Overall, COVID-19 has led to a significant reduction in both income and fishing frequency (Table 5). Mamun et al. [22] also reported that COVID-19 caused a reduction in working hours for fishing related activities, with working hours reduced by 30–40% resulting in a significant loss of income for both small- and large-scale fishers. The nets and boats were also affected during COVID-19 due to lack of use (Table 3B), a finding supported by Bennett et al.'s COVID-19 study [24], who also flagged a reduction in fishing of 80% as boats had to stay in port.

This study also reported the no or limited support to relieve the COVID-19 impact on coastal fishers (Table 3B). The fishers in Patuakhali were provided with free hand sanitizer and face masks, donated by the FISH Safety Foundation, New Zealand, through the fishSAFE2025 project [29]. Mamun et al. [22] however, reported limited non-governmental support (1500 Bangladeshi Taka equivalent to 17.23 USD) from Bangladesh Rural Advancement Committee (BRAC) for fishers, although the Bangladesh government declared a financial incentive of approximately Taka 1.011 trillion (11.90 billion USD) to compensate for COVID-19 economic losses in different sectors including



fisheries [30]. However, obtaining this remains very difficult for fishers due to lack of access to the relevant government agencies and policy-makers [22].

Pressure on food security and the livelihoods of coastal fishers in Bangladesh worsened during the pandemic following the annual government-imposed 65-day ban on fishing in the Bay of Bengal from May 19 to July 23, 2020. This is implemented to improve marine fisheries conservation and management. During this period, the government provides 40 kg rice per month for each registered fishers' family as part of the Vulnerable Group Feeding (VGF) and food security support activity [9]. These support activities were also disrupted and the VGF distribution was delayed due to restricted transportation during the lockdown. Thus, the pandemic was termed as a 'crisis within a crisis' for the small-scale coastal fishers in Bangladesh. The combined result of this led to further food insecurity for the fishers, some of whom may resort to Illegal, Unreported and Unregulated (IUU) fishing. IUU has been identified as increasing since the start of the lockdown by the FAO [23] and Bennett et al. [24], due to the difficulties in delivering VGF support during the pandemic. VGF is the only social welfare system for the registered coastal fishers to support their livelihoods during the fishing ban period. No other social welfare support is available to the fishers. However, during the COVID-19 pandemic it is crucially important to ensure the timely delivery of the VGF and to consider other general or special welfare support to help deter fishers resorting to IUU. To address this crisis, sufficient and special social welfare, and control and monitoring are imperative.

#### 4.3. Policy implications and governance for fisher's social welfare

In Bangladesh, social welfare exists to provide free primary education for all. A monthly stipend is also provided for children from poor families which includes fishers. Additionally a nation-wide stipend programme for girls in secondary (grades 6–10) and higher secondary (grades 11–12) level exists. The second national plan of action (NPA II) in Bangladesh included the provision of child and maternal health, nutrition, and education services [31]. The Bangladesh government implemented a different Social Safety Net Program (SSNP) as part of a Government-to-Person (G2P) support for underprivileged and vulnerable groups of disabled older men and women [32]. The Primary Education Stipend Program (PESP) provides a stipend of Taka 100 per month per child to nearly 10 million mothers through the mobile financial services [33]. Thus, mobile banking accounts and the mobile health information system could provide easy and efficient access to knowledge and preventative practices for COVID-19 and other public health emergency situations.

In Bangladesh, coastal and marine fishing are largely dominated by hilsa fisheries, which represents 12% of the country's total fish production, 1% of the national GDP and more than two-thirds of global hilsa production [9]. Apart from the previously mentioned 65-day fishing ban, the government's 'Hilsa Fisheries Management Action Plan, HFMAP' regulates the nursery hilsa fishing ban period for 22 days in October (the precise date depends on the lunar cycle in the respective year), and juvenile/young hilsa conservation for four months during March-May [9]. During each fishing ban period, the government provides social welfare support of 40 kg rice per month for each fishers' family (those who have a fishers ID card) to support hilsa conservation and management [9]. However, there is no special social welfare for fishers: no health and life insurance for fishers, no bank insurance system for boat owners for their boats or nets, no low interest bank loan for alternate income generation. The government has instituted some additional support during the pandemic: 1040 million Bangladeshi Taka (at 4% interest) [9] for aquaculture production, fish processing industries, hatchery and feed mill owners. So far there have been no special incentives provided for coastal small-scale fishers to compensate for their economic and livelihood losses. During the second lockdown the government planned to facilitate transportation of fish as emergency

food supplies, and to include 5 million fishers under the social safety program as part of SDG [9].

Based on the research findings, governance in social welfare and the current COVID-19 pandemic, the following conclusions and recommendations are made for improving the knowledge, practice and economic aspects of the coastal fishers in Bangladesh. They could also be considered applicable in other high risk public health situations.

## 5. Summary and policy recommendations

COVID-19 has had a profound impact on the reduction of income and the livelihoods of small scale coastal fishers in Bangladesh. Geographically and socio-demographically Cox's Bazar, Patuakhali and the Barguna district are dominated by small-scale artisanal fishing, where full-time fishers have little education and consult with the village doctor for any required health services. Better knowledge about COVID-19 among the fishers was positively associated with higher preventative measures being practised in all of the research areas. The COVID-19 preventative lockdown measures have restricted transportation of fish and led to unavailability of fish labourers, a lower supply of fish and ice, and reduced market prices for fish. This in turn resulted in lower incomes for the fishers, irrespective of geographical area. Fishers experienced an income reduction of 26% while skippers and boat owners faced a higher reduction of 49%. Both the number and duration of fishing trips were reduced during the pandemic in all the research areas. Fishing and income reduction were more prominent in Barguna than Cox's Bazar and Patuakhali. Fishers received very limited or no support from the government, non-government organisations or the private sector. COVID-19 potentially impacts not only the income and livelihood of coastal fishers but the overall economy of Bangladesh.

### 5.1. Recommendations on knowledge and practice aspects

- Good knowledge regarding preventive practices of fishers from Barguna was associated with better literacy or education status. Thus, ensuring education facilities are available to fishers and their family members is vital. Better education is linked to improved awareness and the following of protective measures against COVID-19, or any public health risk issues.
- In the study area, the majority of fishers had access only to village doctors, thus primary health information providers (village doctors, community health clinic) should play an active role in raising awareness and maintaining safety against public health risks. Local health services should be well facilitated and regulated by the local government authorities, which would improve the lives of fishers. Fishers should be motivated and supported in accessing improved health services from government provided community clinics and sub-district hospitals, rather than relying on drug vendors and under-qualified village doctors.
- Lower-income fishers are mostly unable to access health and safety items (sanitizers, face masks etc) to protect themselves during the pandemic. Thus government and non-government support on freely available health/safety items could further improve the preventative practices of fishers.
- Further, registering fishers (with a fisher's ID card) should be provided with health insurance and regular health check-ups in the tertiary or specialized health services that should be made available within these government supported health facilities.

### 5.2. Recommendations on economic aspects

- The study results revealed that fishers had greater economic losses from lower income and fishing frequency but no or limited support obtained from the government or other sources. Thus, greater and immediate financial support from the government is required to scale up improved health, education and food security. Additional

alternative support from international development organizations like the FAO, WHO, and non-governmental development organizations, would also greatly benefit the coastal fishing community in COVID-19 prevention.

- Small-scale coastal fishers should be compensated by the government for the income losses to their livelihoods from COVID-19.
- As a part of social welfare services, low or no interest bank loans should be provided to coastal fishers to foster alternative income generation activities like fish sorting and pre-processing activities at landing centers, fish drying, poultry farming, domestic vegetable gardening and/or agri farming, sewing machines for fisher women.
- Skippers and boat owners should have access to low-interest bank loans for their big investment in boat and net making, and fuel, ice and food for longer fishing operations, where the results show 49% income reduction of skippers and boat owners. Thus, waiving of existing bank loan fees and extension of payment deadlines should also be applicable for the coastal fishers to improve their situation.

### 5.3. Recommendations on other aspects

- Nets and boats were also affected by COVID-19; thus, there is a need to ensure easily sourceable supplies like nets and materials needed for preparing the fishing gear, maintaining the condition of boats, or their recovery.
- Transport restrictions were identified as a major problem that disrupted the regular supply chain of fish in all the study areas. There is a need to provide reliable transport for fish, fisheries products, and relevant goods and inputs (as an emergency food supplies sector) to maintain a smooth fish supply chain to distant markets.
- Due to transport restrictions, the existing social support of rice (as part of VGF) was not distributed to the registered fishers during the fishing ban period, worsening the food insecurity of fishers. Thus an alternate equivalent or more financial support could be provided through the 'mobile banking account, (MBA)' system. Use of the mobile banking system would minimise physical involvement during transportation of goods/rice that could also help to prevent the spread of COVID-19 by means of social distancing.
- Support for the coastal fishers should be provided by means of food rations or funds, provided in a sufficient, safe, dignified, respectful, transparent and equitable way. The law enforcement agency and local administration are bound to protect the poorest and help them access support.

### CRedit authorship contribution statement

**Md. Sazedul Hoque:** Conceptualization, Methodology, Writing-Original draft preparation Supervision; **Despena Andrioti Bygvraa:** Statistical analysis, drafting, editing. **Kate Pike:** Reviewing and English Editing, Visualization, Validation; **Md. Mahmudul Hasan, Muhammad Arifur Rahman and Shaida Akter:** Data curation, Investigation, Resources; **Darren Mitchell and Eric Holliday:** Project administration, and provided comments on all drafts.

All authors confirm that this manuscript describes original work and has neither been published nor submitted for publication elsewhere. All authors read and approved the final manuscript.

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### Conflict of interest

Authors declared no conflict of interest.

### References

- [1] C. Wang, P.W. Horby, F.G. Hayden, A novel coronavirus outbreak of global health concern, *Lancet* 395 (10223) (2020) 470–473.
- [2] World Health Organization, Coronavirus disease (COVID-19) pandemic, (<https://www.who.int/emergencies/diseases/novel-coronavirus-2019>), 2020a, (accessed on 14th August 2020).
- [3] World Health Organization, 2019-nCoV outbreak is an emergency of international concern, (<http://www.euro.who.int/en/health-topics/health-emergencies/international-healthregulations/news/news/2020/2/2019-ncov-outbreak-is-an-emergency-of-internationalconcern>), 2020b, (accessed 14th August 2020).
- [4] World Health Organization, COVID-19 situation report no. #11, ([https://www.who.int/docs/default-source/searo/bangladesh/covid-19-who-bangladeshsituation-reports/who-ban-covid-19-sitrep-11.pdf?sfvrsn=ee79ca3d\\_6World](https://www.who.int/docs/default-source/searo/bangladesh/covid-19-who-bangladeshsituation-reports/who-ban-covid-19-sitrep-11.pdf?sfvrsn=ee79ca3d_6World)), 2020c, (accessed on 16th May 2020).
- [5] Corona Tracker: Bangladesh overview, (<https://www.coronatracker.com/country/bangladesh/>), 2020, (accessed 1st January 2021).
- [6] World Health Organization, (<https://covid19.who.int/table>), 2021, (accessed 28th April 2021).
- [7] World Health Organization, WHO Director-General's opening remarks at the media briefing on COVID-19—11 March 2020. Geneva, Switzerland, 2020, Available at: (<https://www.who.int/dg/speeches/detail/who-directorgeneral-s-opening-remarks-at-the-media-briefing-on-covid-19—11-march-2020>).
- [8] Secondary and Higher Secondary Education Department of Bangladesh Government, ([http://www.shed.gov.bd/sites/default/files/files/shed.portal.gov.bd/notices/d058b83a\\_1755\\_4798\\_aa6c\\_a49f4244105f/130.pdf](http://www.shed.gov.bd/sites/default/files/files/shed.portal.gov.bd/notices/d058b83a_1755_4798_aa6c_a49f4244105f/130.pdf)), (accessed 5th April 2021).
- [9] Department of Fisheries, DoF, National Fish Week Compendium (In Bengali); Department of Fisheries, Ministry of Fisheries and Livestock, Bangladesh, 2020, p. 21–32.
- [10] Department of Fisheries, DoF, Yearbook of Fisheries Statistics of Bangladesh 2016–17. Fisheries Resources Survey System (FRSS), Department of Fisheries. Bangladesh, 2018, p. 129.
- [11] S.S. Mahmood, M. Iqbal, S.M.A. Hanifi, T. Wahed, A. Bhuiya, Are 'Village Doctors' in Bangladesh a curse or a blessing? *BMC Int. Health Hum. Rights* 10 (18) (2010) 18. (<http://www.biomedcentral.com/1472-698X/10/18>).
- [12] M.Z. Ferdous, M.S. Islam, M.T. Sikder, A.S.M. Mosaddek, J.A.Z. Valdivia, Knowledge, attitude, and practice regarding COVID-19 outbreak in Bangladeshi people: An online-based cross-sectional study, 2020. <https://doi.org/10.1101/2020.05.26.20105700>.
- [13] A. Rahman, N.J. Sathi, Knowledge, attitude, and preventive practices toward COVID-19 among Bangladeshi internet users, *Electron J. Gen. Med.* 17 (5) (2020) em245, <https://doi.org/10.29333/ejgm/8223>.
- [14] M.K. Al-Hanawi, K. Angawi, N. Alshareef, A.M.N. Qattan, H.Z. Helmy, Y. Abudawood, M. Alqurashi, W.M. Kattan, N.A. Kadasah, G.C. Chirwa, O. Alshargi, Knowledge, attitude and practice toward COVID-19 among the public in the Kingdom of Saudi Arabia: a cross-sectional study, *Front. Public Health* 8 (217) (2020) 1–10.
- [15] A.A. Azlan, M.R. Hamzah, T.J. Sern, S.H. Ayub, E. Mohamad, Public knowledge, attitudes and practices towards COVID-19: a cross-sectional study in Malaysia, *PLoS One* 15 (5) (2020), 0233668, <https://doi.org/10.1371/journal.pone.0233668>.
- [16] M. Zhang, M. Zhou, F. Tang, Y. Wang, H. Nie, L. Zhang, G. You, Knowledge, attitude, and practice regarding COVID-19 among healthcare workers in Henan, China, *J. Hosp. Infect.* 105 (2020) 183–187.
- [17] FAO, How is COVID-19 affecting the fisheries and aquaculture food systems. FAO Fisheries and Aquaculture Department. FAO document. Rome, 2020. <https://doi.org/10.4060/ca8637en>.
- [18] FAO, The effect of Covid-19 on fisheries and aquaculture in South Asia, FAO Fisheries and Aquaculture Department. FAO document, Rome, 2020. <http://www.fao.org/3/ca9545en/ca9545en.pdf>.
- [19] T. Clavelle, Global fisheries during COVID-19. Global Fishing Watch, 2020. <https://globalfishingwatch.org/data-blog/global-fisheries-during-covid-19/>.
- [20] M.N. Uddin, B. Alam, S.K.S. Islam, M. Arif, M.M. Alam, S.M.L. Kabir, Impact of COVID-19 on food safety and security in low and middle income countries, *Asian J. Med. Biol. Res.* 6 (2) (2020) 130–137, <https://doi.org/10.3329/ajmbr.v6i2.48043>.
- [21] Sunny A.R., Sazzad S.A., Datta G.C., Sarker A.K., Ashrafuzzaman M., Prodhan S.H., Assessing impacts of COVID-19 on aquatic food system and small-scale fisheries in Bangladesh, 2020. doi:10.20944/preprints202006.0143.v1.
- [22] A.A. Mamun, J. Shieh, B. Belton, Qualitative Assessment of COVID-19 Impacts on Aquatic Food Value Chains in Bangladesh, CGIAR Research Program on Fish Agri-Food Systems, Penang, Malaysia, 2020. Program Report.

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- [23] FAO, The impact of COVID-19 on fisheries and aquaculture, A global assessment from the perspective of regional fishery bodies: Initial assessment, May 2020. No. 1. Rome, 2020, <https://doi.org/10.4060/ca9279en>.
- [24] N.J. Bennett, E.M. Finkbeiner, N.C. Ban, D. Belhabib, S.D. Jupiter, J.N. Kittinger, S. Mangubhai, J. Scholtens, D. Gill, P. Christie, The COVID-19 pandemic, small-scale fisheries and coastal fishing communities, *Coast. Manag.* 48 (4) (2020) 336–347, <https://doi.org/10.1080/08920753.2020.1766937>.
- [25] Bangladesh Bureau of Statistics, BBS. District Statistics, Statistics and Informatics Division (SID), Ministry of Planning, Government of The People's Republic of Bangladesh, 2013. (<http://203.112.218.65:8008/WebTestApplication/userfiles/Image/District%20Statistics/Barguna.pdf>; <http://203.112.218.65:8008/WebTestApplication/userfiles/Image/District%20Statistics/Cox%60s%20Bazar.pdf>).
- [26] Worldware.com. <https://www.worldaware.com/covid-19-alert-bangladesh-declares-high-risk-areas-several-districts-june-26>. Published on 26 June 2020 (accessed on 20th November 2020).
- [27] Bangladesh Preparedness and Response Plan for COVID-19. Health Services Division, Ministry of Health & Family Welfare, The Governments of the People's Republic of Bangladesh, July 2020, page 20–23.
- [28] B. McCloskey, D.L. Heymann, SARS to novel coronavirus—old lessons and new lessons, *Epidemiol. Infect.* 148 (2020) 22.
- [29] Lloyd's Register Foundation. 16 April, 2020, (<https://www.lrfoundation.org.uk/en/news/protecting-fishermen-in-bangladesh>), (accessed on 20 November 2020).
- [30] The Financial Express. (<https://thefinancialexpress.com.bd/economy/bangladesh/covid-19-govt-so-far-announces-1190b-stimulus-packages>). Published on May 29, 2020, (accessed on 05th December 2020).
- [31] Save the Children, Government Support to Parenting in Bangladesh and India, *Save the Children*, 2005.
- [32] (<https://a2i.gov.bd/publication/g2p-payment/>), (accessed on 14 April 2021).
- [33] A. Gelb, A. Mukherjee, K. Navis, M. Akter, J. Naima. Primary education stipends in Bangladesh: Do mothers prefer digital payments over cash?, a publication of center for global development, 2019.